Brussels, 13 November 2018

COST 106/18

DECISION

Subject: **Memorandum of Understanding for the implementation of the COST Action "Advanced Engineering and Research of aeroGels for Environment and Life Sciences" (AERoGELS) CA18125**

The COST Member Countries and/or the COST Cooperating State will find attached the Memorandum of Understanding for the COST Action Advanced Engineering and Research of aeroGels for Environment and Life Sciences approved by the Committee of Senior Officials through written procedure on 13 November 2018.

MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA18125
ADVANCED ENGINEERING AND RESEARCH OF AEROGELS FOR ENVIRONMENT AND LIFE SCIENCES (AERoGELS)

The COST Member Countries and/or the COST Cooperating State, accepting the present Memorandum of Understanding (MoU) wish to undertake joint activities of mutual interest and declare their common intention to participate in the COST Action (the Action), referred to above and described in the Technical Annex of this MoU.

The Action will be carried out in accordance with the set of COST Implementation Rules approved by the Committee of Senior Officials (CSO), or any new document amending or replacing them:

a. "Rules for Participation in and Implementation of COST Activities" (COST 132/14 REV2);
b. "COST Action Proposal Submission, Evaluation, Selection and Approval" (COST 133/14 REV);
c. "COST Action Management, Monitoring and Final Assessment" (COST 134/14 REV2);
d. "COST International Cooperation and Specific Organisations Participation" (COST 135/14 REV).

The main aim and objective of the Action is to boost the development of aerogel-based products for biomedical and environmental applications by setting up a multidisciplinary knowledge-based network to facilitate the exchange of ideas, expertise and outcomes by encompassing European-key actors in this field from technological, scientific and market perspectives.. This will be achieved through the specific objectives detailed in the Technical Annex.

The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 72 million in 2018.

The MoU will enter into force once at least seven (7) COST Member Countries and/or COST Cooperating State have accepted it, and the corresponding Management Committee Members have been appointed, as described in the CSO Decision COST 134/14 REV2.

The COST Action will start from the date of the first Management Committee meeting and shall be implemented for a period of four (4) years, unless an extension is approved by the CSO following the procedure described in the CSO Decision COST 134/14 REV2.

OVERVIEW

Summary

AERoGELS COST Action intends to bring together the knowledge on research and technology of aerogels at the European level from academia, industry and regulatory experts. Aerogels are a special class of mesoporous materials with very high porosity and tunable physicochemical properties. Although some types of aerogels have already reached the market in construction materials and aerospace engineering, the full potential of aerogels are still to be assessed for other sectors. In this Action, the use of aerogels specifically for environmental and life sciences applications will be explored in a multidisciplinary approach to tackle two of the current main European challenges: circular economy and active ageing. The scope of the Action is to advance the state-of-the art on the topic by joining the knowledge and efforts of the most renowned experts on cutting-edge aerogel technology, on advanced characterization of materials as well as on biomedical and environmental research. Aerogels will be assessed from a materials performance point of view but also regarding health and environmental implications. AERoGELS Action will set a forum to disseminate knowledge to society, to boost the industry-academia interactions and to train European young researchers on research, innovation and entrepreneurial skills via technical schools, publications and STSM exchanges. Finally, the interdisciplinary collaborations are expected to yield innovative and integrated solutions for environment and for life sciences. The long-term scope of this Action is to develop an aerogel technology able to improve the welfare of European people and to move towards cleaner and smarter production in Europe.

Areas of Expertise Relevant for the Action	**Keywords**
● Materials engineering: New materials: oxides, alloys, composite, organic-inorganic hybrid ● Medical engineering: Medical engineering and technology ● Chemical engineering: Chemical engineering: processes and products (others) ● Nano-technology: Nano-materials and nano-structures ● Environmental engineering: Environmental and geological engineering	● aerogel ● advanced materials ● biomedical applications ● environmental applications ● materials engineering

Specific Objectives

To achieve the main objective described in this MoU, the following specific objectives shall be accomplished:

Research Coordination

● To establish clusters within the COST consortium with academia and companies that will early define the specific cutting-edge bioactive aerogels to be developed, considering their market impact.
● To establish clusters between COST-members from academia and companies that will early define the specific innovative aerogel features and products to be developed for environmental applications, considering their market impact.
● To explore novel or modify existing chemical (sol-gel) and physical (e.g., drying) routes for aerogel processing, and to develop and adapt analytical tools for aerogel characterization and performance.
● To evaluate innovative aerogel processing approaches to turn advanced materials development from lab-scale into commercial products from technological, safety and economical points of view.
● To set the basis of a common knowledge on aerogels regarding toxicity, health, risk safety assessment, environmental impact and regulatory issues.

Capacity Building

● To identify the opportunities of aerogel technology to give response to the current European demands in the fields of biomedicine and environmental application.
● To set up a network or community on aerogel technology in a lifelong basis going beyond the timeframe of the COST Action by facilitating the joint application in consortia to open project calls from

European/international funding programmes.
● To assemble trans-disciplinary expertise on nanostructured materials from different domains (industry, academia, regulatory experts) and disciplines (raw material suppliers, technology developers, R&D, manufacturers).
● To join together research efforts, best working practices, expertise and facilities from the Action members to reach the main aim of the Action.
● To train early stage researchers and students for skills development with courses and exchange activities to become the next-generation scientific and technological leaders.
● To promote, disseminate and share knowledge on aerogel technology to academia, industry and society through different media (scientific articles, books, patents, leaflets, web page, participation in congresses and exhibition fairs, Master and PhD Thesis, mass media).

TECHNICAL ANNEX

1. S&T EXCELLENCE

1.1. CHALLENGE

1.1.1. DESCRIPTION OF THE CHALLENGE (MAIN AIM)

Aerogels are unique nanostructured porous materials containing >90 vol% air and entitled with special properties (Fig. 1) of utmost interest for certain advanced applications[1]. However, biomedical and environmental applications are two emerging market opportunities in Europe that are still unexploited for aerogels up to now and will be explored within this Action. AERoGELS Action aims to fill this gap.

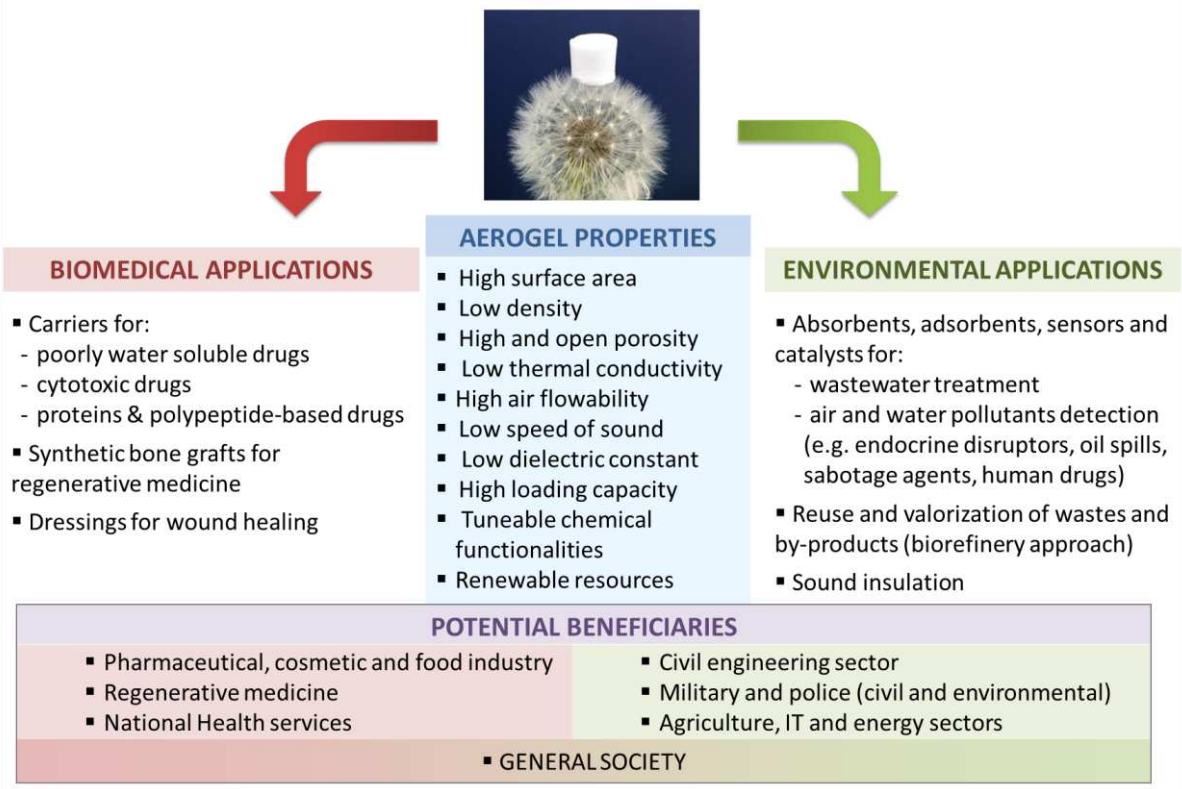

Fig. 1. Advanced biomedical and environment applications to be prospected in AERoGELS Action

Current challenges in biomedicine are interlinked to the new socio-sanitary needs in Europe and worldwide derived from the dramatic demographic changes and new population lifestyle taking place[2]. Namely, European population is experiencing an outstanding increase in longevity with 18.5% people above 65 years already in 2014 and a prospect of 29.5% by 2060. New materials and approaches should provide solutions to enhance the quality of life and well-being at least at the same pace as the population ages and the prevalence of chronic diseases (cancer, cardiovascular, diabetes) rises. However, the lack of sufficient interdisciplinary collaboration between academia and industry and between different scientific domains results in a fragmented knowledge severely jeopardizing the development of the next-generation medicines and grafts able to respond to the new social demands.

For environmental applications, a change towards circular economy, a more sustainable management of resources, is one of the main pillars to be addressed by Europe in the current context of ever-increasing energy (50% more by 2030) and water (40%) demands[3-5]. This new environmental model is crucial to tackle the climate change and to avoid potential risks of water and food shortages. This new paradigm goes beyond environmental concerns and is part of a structural change in the European economy to mitigate external dependence and to maximize competitiveness to reach a prolonged prosperity of the continent. The collaboration in research between all the actors from the value chain as well as a suitable interaction with regulatory experts on circular economy are needed to promote this new environmental context and to reach the defined milestones with success and on time.
Overall, current research efforts on nanostructured materials for biomedical and environmental applications have severe limitations in terms of yield, reproducibility and toxicity[6-8]. These pitfalls translate into cumbersome processing techniques and limited cost-efficiency that restricts the access to the market. Novel advanced nanostructured materials, particularly aerogel-based materials, are susceptible of contributing to reach the mentioned challenges circumventing the said limitations[9-10].
The main aim of AERoGELS Action is to boost the development of aerogel-based products for biomedical and environmental applications by setting up a multidisciplinary knowledge-based network to facilitate the exchange of ideas, expertise and outcomes by encompassing European key actors in this field from technological, scientific and market points of view. The Action will bring together key actors from academia and industry from materials science, chemical engineering, biology, environmental chemistry, pharmaceutical technology, physics, pharmacology, regenerative medicine and toxicology domains as well as regulatory experts and innovation managers to boost together the development and applications of aerogels as high added value products. The obtained advanced materials will be used in biomedical and environmental applications for several potential sectors as beneficiaries and, particularly, the general society (Fig. 1). Many of the aerogels within this Action will be processed from renewable resources (polysaccharides and proteins) thus participating to the sustainable bio-economy approach by obtaining specialty products from commodity polymers.

1.1.2. RELEVANCE AND TIMELINESS

Aerogel-based products can actively contribute to solve the current unveiled challenges in biomedicine and environmental remediation, where novel formulations and innovative nanostructured materials are explored to render products with predictable morphologies and a precise control of their properties. Namely, novel aerogel-based formulations retaining components previously approved by regulatory agencies are of particular interest for biomedical applications from regulatory and economical perspectives. Advanced carriers are under research in pharmaceutical technology to tackle current limitations in the formulation of proteins, cytotoxic drugs and low-water soluble drugs regarding stability enhancement, side effects minimization and therapeutic effect. In regenerative medicine, novel synthetic nanostructured scaffolds are being prospected to overcome the problems of availability (>$2 \cdot 10^6$ procedures per year worldwide for bone grafting), slow recovery, infections and unwanted responses occurring with biological grafts, the gold standard. For wound healing, the use of aerogels in medical devices allows the gelation only into the lesion and keeps a proper exudate equilibrium at the wound, avoiding the traumatic removal from perilesional skin of conventional products.
For environmental applications, Europe seeks innovations regarding low carbon emissions processes as well as air and water treatments to prevent health and environmental risks arising from pollutants (greenhouse gases, nanoparticles carried by flue gas, carcinogenic compounds, endocrine disruptors, heavy metals, sabotage agents or medicines with additive effects) in humans, biota and environment. These new solutions for pollutants should embrace all the steps of the circular economy model: process innovations to mitigate emissions, novel analytical tools allowing faster detection and at lower concentrations, and the development of prompt and highly efficient remediation techniques.
Despite the unique properties of aerogel-based materials having urged the emergence of novel commercial solutions in several fields (thermal insulation, textiles, aerospace engineering), there is still a paucity of information regarding the potential application of aerogels for biomedicine (pharmaceutical technology, regenerative medicine, wound healing) and environmental solutions (sound insulation, air cleaning, water pollutant treatment), where no aerogel-based product has reached the market yet. The state-of-the-art for these fields is mainly precluded to aerogel research from engineering and materials science points of view and where intersectorial collaborations are still scarce. The relevance of the topic can be ascertained by recent review articles[9-17] and two on-going editorial projects: the second edition of the Aerogels Handbook[1], and other book fully devoted to bio-based aerogels[18]. AERoGELS Action provides the ideal set-up to assemble European expertise to evaluate the potential of aerogels as advanced materials intended for biomedical and environmental applications. This collaborative initiative will set a scientific and technological platform to generate added value solutions in terms of scientific knowledge, high-performance materials, and efficient, health-compliant and environmentally

responsible technologies. Finally, AERoGELS Action will set the basis of future international collaborations, notably as joint-research projects within the Horizon 2020 (H2020) and subsequent Programmes.
The timeliness to implement this Action is ideal since the concepts of active ageing and circular economy are looking for novel advanced materials and approaches for biomedical and environmental applications, respectively. This technological prospective is validated by the myriad of H2020 calls fitting the scope of this Action, and by the forthcoming European social (ageing of population) and economic (circular economy, added-value innovative products and energy-efficient solutions against foreign low-cost alternatives) paradigms. For environmental applications, there is a major concern in the protection of resources (Water JPI) and in the valorisation of wastes and by-products using biorefinery approaches (BioBased Industries PPP). In biomedical applications, there is a specific H2020 R&I Challenge (Health, Demographic Changes and Welfare) and other European calls (EIT Health, KIC in Active Ageing, InfectERA) seeking high-performance, reliable, safe and reproducible products to give response to the current European demographic scenario of longevity by extending their lifetime efficiency and a more effective and responsible use of drugs (e.g., antimicrobials).

1.2. OBJECTIVES

1.2.1. RESEARCH COORDINATION OBJECTIVES

This Action will assemble the diverse expertise from the participants in different Working Groups (WG) to accomplish the main aim of evaluating aerogels as advanced materials for biomedicine and environment from scientific, technological and market-oriented perspectives. The initial consortium encompasses the expertise needed to reach this objective and is expected to act as pole of attraction for other relevant and emerging researchers linked to the topic of the Action. The cooperation between the AERoGELS COST-members is essential to effectively tackle the research coordination objectives of the Action (see metrics for their monitoring in the table below):
i.1. To establish clusters within the COST consortium with academia and companies that will early define the specific cutting-edge bioactive aerogels to be developed, considering their market impact.
i.2. To establish clusters between COST-members from academia and companies that will early define the specific innovative aerogel features and products to be developed for environmental applications, considering their market impact.
i.3. To explore novel or modify existing chemical (sol-gel) and physical (e.g., drying) routes for aerogel processing, and to develop and adapt analytical tools for aerogel characterization and performance.
i.4. To evaluate innovative aerogel processing approaches to turn advanced materials development from lab-scale into commercial products from technological, safety and economical points of view.
i.5. To set the basis of a common knowledge on aerogels regarding toxicity, health, risk safety assessment, environmental impact and regulatory issues.

Objective indicator	Metrics
i.1 Scientific contributions‡ on aerogels for biomedical applications	35
i.2 Scientific contributions‡ on aerogels for environment applications	35
i.3 Scientific contributions‡ on aerogel synthetic routes and characterization tools	30
i.4 Number of academia-industry collaborations (STSM, joint project applications, industrial participation in events)	30
i.5 Number of external documents on health risk assessment	25

‡ Peer-review papers, proceedings and patents

1.2.2. CAPACITY-BUILDING OBJECTIVES

This Action will merge fundamental and applied research to build up a robust interdisciplinary scientific cooperation with the common scope of developing materials, technologies and protocols able to advance on the state-of-the-art of aerogels for environment and life sciences applications. AERoGELS Action will encompass theoretical and experimental knowledge on the topic joining forces to carry out the challenge of getting precise materials design, reproducible processes and society-demanding solutions. The creation of technology-based start-ups and spin-offs will be a logical outcome of this Action. All the actors from the value chain (raw material suppliers, researchers, technology providers, manufacturers and regulatory experts) will be integrated to achieve these complex tasks. Overall, the cooperation between the AERoGELS members is essential to effectively tackle the specific capacity-building objectives established for this Action:

ii.1. To identify the opportunities of aerogel technology to give response to the current European demands in the fields of biomedicine and environmental application.
ii.2. To set up a network or community on aerogel technology in a lifelong basis going beyond the timeframe of the COST Action by facilitating the joint application in consortia to open project calls from European/international funding programmes.
ii.3. To assemble trans-disciplinary expertise on nanostructured materials from different domains (industry, academia, regulatory experts) and disciplines (raw material suppliers, technology developers, R&D, manufacturers).
ii.4. To join together research efforts, best working practices, expertise and facilities from the Action members to reach the main aim of the Action.
ii.5. To train early stage researchers and students for skills development with courses and exchange activities to become the next-generation scientific and technological leaders.
ii.6. To promote, disseminate and share knowledge on aerogel technology to academia, industry and society through different media (scientific articles, books, patents, leaflets, web page, participation in congresses and exhibition fairs, Master and PhD Thesis, mass media).

Objective indicator	Metrics	Comments
ii.1 Number of COST events (workshops, meetings, training schools, conferences, STSM)	50	In-house workshops will be organized to promote industry participation
ii.2 Number of applied joint projects by Action members	25	Target application success rate: 30%
ii.3 Percentage of academia-industry STSM exchanges	10%	11 industrial partners already interested in the Action
ii.4 Number of joint publications from at least 2 Action members	30	15 best collaborative work prizes and Open Access articles during the Action
ii.5 Average percentage of ECIs per year involved in the Action (members, STSM, event participants)	60%	39% of the first Action consortium members are ECIs
ii.6 Total number of scientific publications, meeting contributions and mass media participations	300	2 special issues on the Action in peer-reviewed journals will be edited

1.3. PROGRESS BEYOND THE STATE-OF-THE-ART AND INNOVATION POTENTIAL

1.3.1. DESCRIPTION OF THE STATE-OF-THE-ART

Aerogels are a special class of materials able to encompass unique properties like high porosity, light-weight, outstanding textural properties such as high specific surface area and tunable surface chemistry[1]. Namely, the low density and the high porosity in the mesoporous range of aerogels have been notably exploited for thermal insulation in building materials and aerospace technology. Several products are already commercialized for these specific applications (e.g., insulating pipes/boards/ blankets/translucent panels). Aerogel source has been traditionally precluded to synthetic organic polymers (e.g., resorcinol-formaldehyde, polyurethane) and inorganic oxides (typically silica). Nevertheless, natural biopolymers (polysaccharides, proteins) and hybrid materials have been recently considered as new aerogel sources with an exponential increase in the publications on bio-aerogels during the recent years[16]. Natural biopolymers are of special interest for biomedical (biocompatibility and biodegradability) and environmental (renewability) applications[12,15]. Well-known natural polymers (cellulose, starch, pectin) can be transformed into high-added value aerogel-based materials. New materials from biopolymers (e.g., nanocellulose) in the form of aerogels also have promising biomedical and separation applications among others[11].
From a technological point of view, supercritical fluid-based drying of gels is regarded as the most suitable aerogel end-processing approach[13]. Optimization and integration of the supercritical drying process from an economic and environmental perspective as well as alternative drying processes have been actively sought. Overall, four main issues on aerogel technology are generally recognised as critical and not fully explored yet: (1) To extend the use of aerogels for biomedical and environment applications; (2) To develop aerogels with selective response to external stimuli and with smart behaviour; (3) To establish robust prediction models and characterization tools for the quality control of aerogels; (4) To set manufacturing protocols for the safe and reproducible processing of aerogels.

1.3.2. PROGRESS BEYOND THE STATE-OF-THE-ART

The survey of literature, patents and previous research on aerogels unveils the biomedical and environmental applications as two important and prospective directions for the development of aerogels. Process and materials engineering, scaling–up as well as toxicity, health, risk assessment and regulatory aspects must be taken into account to successfully advance in these directions. These points have not been considered in open literature so far and will be addressed in this Action.

For pharmaceutical applications, this Action aims at compiling the state-of-the-art and extending the knowledge on aerogel formulations to obtain better therapeutic outcomes with modified drug release profiles, improved recovery times and/or improved acceptance and adherence of the patients. The advantages of the use of bio-based aerogels as carriers are improved dissolution rate of poorly water soluble drugs, high specific drug loadings, enhanced stability of amorphous drugs and excellent air flowability, which are requested for certain administration routes (oral, pulmonary, nasal)[12,14-15]. To reach the Action objectives, partners will develop new formulations and the processing of innovative aerogel-containing dosage forms. Smart aerogel formulations showing tuneable stimuli-responsive drug release behaviour relevant to the intended administration route/target site, being able to deliver cytotoxic drugs (e.g., anti-cancer drugs) with enhanced therapeutic effect, or being compatible with the incorporation of proteins and polypeptide-based drugs are among the foreseen progresses to be achieved. From the processing point of view, the handling (powder flow properties, stability under storage), dosing (tableting), manufacturing (integrity under tableting, shaping of the aerogel morphology, choice of packaging) and validation of the aerogel dosage forms for different therapeutic applications and administration routes, as well as the implementation of the aerogel processing under Good Manufacturing Practices conditions are to be endeavoured within this Action.

For regenerative medicine and wound healing, important progresses have been attained in the last years for aerogel-based scaffolds[10], but should still be regarded as an emerging alternative under evaluation concerning methods for the processing of nanostructures mimicking natural tissue and with biological compatibility tests pending. The progresses to be attained within AERoGELS Action deal with the materials design and regulatory compliance. Accordingly, efforts will be devoted, on one hand, to get a robust processing method to confer a controlled macroporosity to the aerogels allowing host cell colonization, or promoting allo- and xenocells proliferation, to engineer aerogel synthetic methods able to improve the mechanical properties of the scaffolds to temporarily surrogate natural tissue without compromising the biocompatibility of the material, and to allow the incorporation of bioactive compounds (e.g., growth factors) in high yields and with retained activity to promote the biological tissue growth[19]. From a regulatory point of view, the cytocompatibility and sterility of the aerogel-based materials should be predicted beforehand by developing precise methodologies able to ensure the presence of organic solvents or crosslinkers at concentrations below cytotoxic levels and to guarantee sterility assurance level (SAL) 6 sterility conditions for aerogel implants, as needed by regulatory agencies. For the specific case of wound healing[20], the potential of aerogels as therapeutic platforms to promote and accelerate the natural wound healing process through a control of the presence of a balanced exudate in the wound surroundings, gas permeability (transpiration) and sustained release of bioactive compounds will be explored and compared to the benchmark.

For environmental applications, this Action will develop aerogels with better performance than the current solutions (if any) in the market in terms of reliability, fast response and ease of use, coupled to (i) the explorative search of new raw materials and feedstocks, (ii) a processing with a responsible management of resources, and/or (iii) a competitive production cost. Accordingly, a critical study of aerogel sources coming from the biorefinery approach will be explored for the reuse or valorization of wastes (wasted newspaper, waste biomass) and by-products (lignin). Physicochemical modifications of current aerogel sources in terms of morphology and chemical functionalities will be actively prospected for environmental applications[16-17]. Namely, aerogel-based products giving improved response to the capture and/or degradation of oil spills and various toxic compounds will be developed in the form of absorbents, adsorbents or catalysts[21-24]. The recovery of pollutants with economic interest will be also considered in the adopted approaches. Moreover, new sensor solutions for the fast detection of air and water pollutants (endocrine disruptors, sabotage agents, metabolites, human and veterinary drugs, pesticides) with reduced sampling times and high sensitivities are also an urgent environmental concern to be performed within this Action using aerogel-based stationary phases[12]. Finally, promising aerogel solutions will be implemented using rigorous processing designs with full integration of utilities to minimize energy consumptions and to reduce and (when applicable) reuse raw materials for the sake of process economics and of environmental and health-and-safety issues.

Concerning risk and regulatory issues, there is a paucity of information regarding the health risk assessment and other regulatory aspects on these materials. A “library of knowledge” and protocols for the health risk assessment of aerogels will be generated during the Action lifetime. This safety regulatory compendium will be crucial to advice on the commercialization possibilities of the different

aerogel-based formulations coming out from the collaboration within this Action. In addition, protocols with the best practices for handling and processing aerogels will be elaborated to mitigate risks.
Overall, AERoGELS Action will fulfil the abovementioned objectives and final goals by bringing together the joint efforts of scientists from different domains and supported by industry in the frame of a defined work plan (Section 3.1) and the transfer of knowledge between academia and industry and society by means of a dissemination and exploitation plan (Section 2.2.2).

1.3.3. INNOVATION IN TACKLING THE CHALLENGE

The traditional development of aerogels have been carried out by materials scientists and process engineers with expertise in the technology, but not necessarily familiar with the knowledge and the regulation concerned for the production of aerogels for environmental and, particularly, biomedical applications. As an example, conferences on aerogels are mainly taking place as specific workshops or as parallel sessions within technological meetings on sol-gel chemistry, process engineering or material science. To the best of our knowledge, no specific sessions on aerogels have been organized within conferences on biomedicine, regenerative medicine or environmental applications. Additionally, no previous COST Action on the development and applications of aerogels has been funded so far.
The innovation of AERoGELS Action is to tailor aerogel technology to the social demands regarding health and environment through the interdisciplinary collaborations between the Action-members. The COST Action is accordingly structured in different Working Groups (*cf.* Section 3.1.1) by encompassing aerogel technologists (WG3) with biomedical (WG1: medical doctors, biologists, pharmacists, bioengineers), environmental (WG2: gas cleaning, water remediation, biorefinery, catalysis), regulatory experts (WG5: attorneys, agencies, associations, NGOs) and other stakeholders (WG4: raw material and end product industries, innovation managers, IP-lawyers, NGOs). The research activities of each COST-member will be in their core area to guarantee their funding by already existing projects, but now enhanced by the cooperation within this COST Action. The activities of the Action will be carried out through a translational **technology↔application bidirectional information flow**: for example, technology-based conferences and meetings to be scheduled by this Action will be organized as satellite or parallel events of application-based international congresses and symposia and *vice versa*. The training schools will also promote this challenge by assembling experts and early career researchers (ECIs) from both domains **to train the future first-generation of research leaders** on aerogel-oriented biomedical and environmental applications. Research stays (STSM) within the Action will also promote this bidirectional collaboration as well as the academia-industry exchanges, the latter of utmost importance to **turn potential aerogel-based materials inventions into innovations** able to reach the biomedical and environmental markets. The **involvement of industrial members** of the COST Action and regulatory experts will be also promoted through in-house workshops and preferential invitations as lecturers in COST events. Finally, selected academic partners (at least from five different European countries) will incorporate the topic of aerogels as a subject itself or as a module in MSc or PhD studies from both technological and biomedical/environmental disciplines before the end of the Action lifetime as a **long-term "legate" of the Action objectives** to ensure the training of the second and following next-generations of aerogel-oriented biomedical and environmental experts to lead future innovations in these fields.

1.4. ADDED VALUE OF NETWORKING

1.4.1. IN RELATION TO THE CHALLENGE

Active ageing and circular economy are current mainstream challenges in Europe[4,25]: the EU devoted the European Year 2012 to promote active ageing as a basis for solidarity between generations and currently there are several active R&I research programmes on this topic; in September 2016 the EU endorsed the Paris agreement towards more energetic efficient and low carbon economy and the 2030 climate and energy framework sets the roadmap for the next decade. The design and engineering of aerogels with special properties can shed light to tackle the current biomedical concerns and to give priority to energetic efficiency. However, the main challenge in the development of aerogel-based solutions for these fields is the fragmentation between the technology and application, coupled to an academia-industry-national agencies interlinking to be improved. As a result, there are no aerogel-based products in the market for biomedical and environment applications so far, in spite of their high potential. A novel paradigm with a suitable alignment between technological developments on aerogels and the design needs for the intended application through a jointly, multidisciplinary and multisectorial approach is crucial to reach research excellence and to boost the technological progresses on the topic.

AERoGELS Action will assemble renowned European and international experts from different disciplines (chemical process engineering, biological sciences, materials science, environmental chemistry, drug delivery, regenerative medicine, pharmaceutical technology, national agencies, physics, pharmacology, toxicology) to look for a more effective technological approach in the development of aerogels if compared to the previous fragmented and sporadic ones. The activities to be implemented during this Action will boost these advances on applied aerogel technology to reach the leadership of Europe and affiliated COST countries on the topic.

1.4.2. IN RELATION TO EXISTING EFFORTS AT EUROPEAN AND/OR INTERNATIONAL LEVEL

The aims and scope of this COST Action are exclusive and not replicated in active calls in the COST, ERA, EIT, IMI, or H2020 R&I programmes. Nevertheless, the Action is aligned with the Active Ageing and Circular Economy concepts, which are parts of the roadmaps of the European Commission and National Programmes for the forthcoming years and decades. Therefore, this Action will strengthen current European research projects providing them with a more interdisciplinary dimension, and will also act as a seed for the set of new consortia for the preparation of collaborative research proposals.
AERoGELS Action has no overlap with previous COST Actions but interesting complementarities. Certain COST Actions (MP1301, CA15114, MP1404, CA16205, CA16202, TD1407, CA17136) have been devoted to different specific biomedical (inhalation, oral administration, regenerative medicine, infectious diseases) and environmental (air pollution, human health threats) applications. To broaden the scope, audience and impact of AERoGELS Action, the Management Committee (MC) will look for liaisons and synergies with these Actions by i) learning from results of already closed Actions, ii) contacting the MCs of the active COST Actions for the organization of joint events, and iii) prospecting their Action members for hosting scientific missions and for being speakers in AERoGELS-events.

2. IMPACT

2.1. EXPECTED IMPACT

2.1.1. SHORT-TERM AND LONG-TERM SCIENTIFIC, TECHNOLOGICAL, AND/OR SOCIOECONOMIC IMPACTS

AERoGELS Action endeavours the search for materials innovations on aerogels for biomedical and environment applications, two unmet fields for these materials so far. This Action will represent in the short-term a highly needed collaborative network for **scientific-technological** advances by matching knowledge and expertise on the best processing practices on aerogel technology and on the materials performance taking into account the required specifications and regulatory aspects for the intended application. The networking and knowledge exchange efforts undertaken during this Action will set the basis of forthcoming scientific-technological joint collaborations and the filing of patents leading to ground-breaking product developments reaching the market in a mid-long term. The exploitation of the scientific-technological results will be carried out by potential “spin-off” companies resulting from the Action, by the industrial Action members or by license agreements with other existing companies.
From a **socioeconomic** point of view, AERoGELS Action has an upside potential in biomedical and environmental applications with the development of advanced technologies and products based on the use of aerogels. For biomedical applications, better clinical outcomes resulting in reduced recovery time periods and the subsequent savings in direct (hospitalization) and indirect (sick leave and in-home healthcare expenses) costs of the treatments are the expected results from the use of aerogels in a global context of aging population as primary social driver to burgeon healthcare expenses. For pharmaceutical technology, the novel formulations to be herein endeavoured will likely increase the therapeutic efficiency of the treatment (improved lung deposition by oral inhalation, improved dissolution rate of poorly water-soluble drugs in oral drug delivery, enhanced drug permeation in nasal delivery) leading to economic savings and higher social adherence[2,8]. For regenerative medicine, cost-effective and safe aerogel materials aim to give response to the availability problems and deficient tissue recovery of current grafts. The global market only for bone implants is of *ca.* 5,000 M€/yr[25-26]. For wound healing, the target is to develop advanced dressings able to prevent or to heal chronic wounds such as diabetic foot ulcers (15% incidence among diabetic patients and main cause of non-traumatic amputation of the lower extremity) or pressure ulcers (representing *ca.* 4% of total national sanitary costs)[20]. This use of aerogels aims to become a high growth technology for the market of advanced bioactive dressings representing *ca.* 500 M€/yr worldwide and a top growth segment

(expected annual growth: 15-25%)[27]. For environmental applications, the reduction of water and air pollution, energy savings, responsible use of resources and fast detection of pollutants are expected results from the Action activities. New cheaper and/or more effective materials will be suggested for water treatment and air/gas stream cleaning. This Action will thus contribute to the reinvention of the European economy towards process innovations following the circular model of efficient and responsible management of resources and low carbon emissions estimated at 2.7 trillion €[28-29].

2.2. MEASURES TO MAXIMISE IMPACT

2.2.1. PLAN FOR INVOLVING THE MOST RELEVANT STAKEHOLDERS

The transdisciplinary context and capacity-building objectives of this Action coupled to its expected high socioeconomic impact results in a wide societal range to be involved as stakeholders:

- Public research institutions: universities and research institutes will be the major group of the Action. PhD students and young postdoctoral scientists will be involved with specific activities (ECI's Forum, STSM) and training schools on scientific and transversal skills. Tenure-track professors will be involved as invited speakers in training schools and scientific events and will participate in academia-industry collaborations to boost the valorisation of results.
- Industry: the involvement of profit-driven companies as raw material suppliers for aerogels, technology suppliers or end-user biomedical and environmental products will be actively promoted within the Action. A high share of participation of these stakeholders, with special attention to SMEs, will be promoted with in-house technological events and specific quotas (*ca.* 10%) for the participation in STSM and scientific events. A "Forum of Emergence" will be also organized (Section 2.2.2).
- Clinical practitioners and patient organizations will be regularly updated with news (Section 2.2.2) on the Action progresses for the biomedical application-driven aerogels to avoid misinterpretations of the materials use and to promote the translation to clinical trials. They will be also invited to participate as speakers in training schools or as attendants in biomedical-oriented COST scientific events.
- Regulatory agencies, NGOs and environmental organizations will be invited to participate in this Action and the MC will have a fluid communication to ensure the alignment of the application-driven aerogels with the European legislation (e.g., health and safety issues, European Medicines Agency-guidelines).
- General society will be the major beneficiary of the scientific outcomes of the Action. The results of the Action will be European researchers trained with advanced skills and the development of advanced technological solutions that translate into higher employability, economic competitivity and welfare state in Europe. A dissemination plan for the general public is foreseen (Section 2.2.2).

2.2.2. DISSEMINATION AND/OR EXPLOITATION PLAN

The relevance and timeliness of the scope of this Action urge the implementation of a dissemination and exploitation plan able to reach the broadest of the audiences (*cf.* Section 2.2.1). The key message of the Action will be adapted to each specific audience for a more efficient communication. Different activities will be carried out: *1)* to share the technological and scientific outcomes, *2)* to discuss and exchange different points of view to boost the setup of new research topics and collaborative projects, *3)* to increase the impact of the Action on policy makers and *4)* to raise awareness of the Action:

- Workshops, conferences and seminars for COST and non-COST participants to spread results and knowledge to the research community and to promote networking for future collaborations.
- Scientific publications and reviews in high impact factor journals to set research prospects in the fields and to disseminate milestones of the Action. Whenever possible, publication in Open Access will be financially promoted. A specific website of the COST Action will be set and weekly updated. e-newsletters (each semester), press releases (on Action impacts and achieved milestones), agenda and fact sheets will be publicly accessible. The web will include an Intranet for Action members with scientific documents and Action forms. Twitter and Facebook accounts will be also set for the Action.
- Opinion papers and recommendations will be published to have a high impact and to meet consensus among the different stakeholders of the Action.
- Educational material, videos, press releases, interviews and articles in EU-media, national or regional press seeking a large array of audiences will be disseminated in close collaboration with the Public Relations and Community Offices of the COST Action-member institutions.

• Standard documents will be developed to be proposed to CEN, related to safety protocols when handling and processing aerogels, and the best practices for characterization of aerogels.
• Public lectures and in-house meetings will be organized in every COST Action-country to widen the communication with the general society and with key industrial companies, respectively.
• Regarding intellectual property rights (IPR), the standards from the European Patent Office will set the common rules for all the COST Action members and the ownership and inventorship criteria. The IPR plan will include i) invited talks in COST events for IPR training; ii) promotion of results protected by patents as a dissemination tool and publication in the Action web page; iii) organization of a "Forum of Emergence" consisting on business-to-business meetings, elevator pitches and talks between academic members and industry to offer networking opportunities, cross-training to professionals, feedback from stakeholders and collaborative agreements so that society could benefit from the knowledge generated in the Action.

2.3. POTENTIAL FOR INNOVATION VERSUS RISK LEVEL

2.3.1. POTENTIAL FOR SCIENTIFIC, TECHNOLOGICAL AND/OR SOCIOECONOMIC INNOVATION BREAKTHROUGHS

In this Action, the use of aerogel technology through an interdisciplinary collaborative approach is regarded as a *win-win* strategy to provide compliant materials designs in terms of yield, reproducibility and toxicity to the current social needs in biomedicine and environment. The choice of the proper material science-technological approach combination to obtain an advanced material adapted to the intended biomedical or environmental application is claimed to give rise to important innovation breakthroughs in the field. Although the risk in scientific-technological development is present (Section 3.1.3), since there are no aerogel-based medical devices or environmental applications in the market, the unique expertise assembled in this Action covering the whole value chain can undergo the challenge and reach a significant impact. The said impact is linked to the unresolved applications (chronic wound healing, cancer, bone scaffolds, sound insulation, air and water pollution monitoring and remediation) to be targeted and the subsequent socioeconomic relevance. The risk of feasibility of the Action can be considered as relatively low, since many of the desired properties for the end materials have been already individually achieved on laboratory scale and will be herein encompassed with the support of an interdisciplinary network. The risk of products and technologies not being cost-competitive for biomedical and environment applications (gross margins>60%) is also low since there are aerogel products in markets with lower venture profitability (e.g., building insulation, 20-30%) [30-31]. There is also a high potential for IP generation through improved product performance with margins in order of magnitudes. Moreover, like-for-like substitution of most products with aerogels using the same raw materials (polysaccharides, proteins) is possible without significant increase in operating costs, and the common solvents (water, alcohol, CO_2) used for aerogel processing are already individually accepted by agencies thus reducing the associated risks and costs for regulatory compliance. The key missing factor is the awareness of aerogels in new market sectors that this Action can address. Finally, even in case of failure in application, the vast knowledge generated within the Action will result in established protocols and guidelines easily transferred to other applications in the same fields.

3. IMPLEMENTATION

3.1. DESCRIPTION OF THE WORK PLAN

3.1.1. DESCRIPTION OF WORKING GROUPS

AERoGELS Action consists of 5 Working Groups (WGs), which are highly interlinked (Fig. 2) to reach the Action objectives.

As an example, training schools will be organized by a specific WG but all COST-members can participate to boost cross-fertilization between WGs.

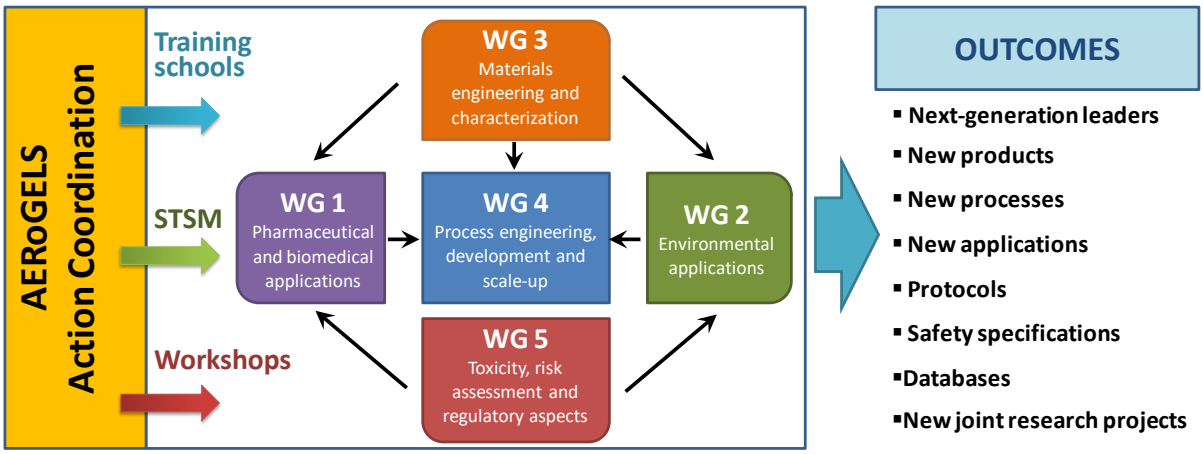

Fig. 2. PERT chart of AERoGELS Action: WG-descriptors, WG-interrelations and expected outcomes

WG1. Pharmaceutical and biomedical applications of aerogels

Objective – To design and develop aerogel-based products as drug delivery systems for pharmaceutical technology, or as medical devices for wound healing and tissue regeneration

Tasks

• Development of new therapeutic platforms based on aerogel particulate systems able to significantly improve the drug bioavailability and to control the delivery of bioactive molecules

• Formulation of aerogel beads and scaffolds able to gel in presence of wound exudate enabling the treatment of chronic wounds and able to maximize the effect of encapsulated APIs

• Processing of biodegradable aerogel-containing scaffolds for regenerative medicine with suitable morphological, mechanical and biological properties for bone repair able to maximize osteointegration

Activities

• To develop aerogel-based medical devices and carrier formulations loaded with biomolecules (poorly water soluble drugs, cytotoxic drugs, proteins) and with new administration strategies. Aerogels will be designed to amorphize drugs (e.g. adsorptive precipitation) and to modulate the release profile depending on formulation composition and manufacturing technique (e.g. smart release and multiple release of different biomolecules). These properties will be validated by defining the carrier material and the carrier-biomolecules interactions with the dynamic physiopathological environment

• To characterize the textural properties of aerogel particles and scaffolds as well as specific properties for wound healing treatments (gelation properties, exudate absorption, transpiration) and bone repair (cell infiltration and colonization capacity, 3D-modelling, sterility, tissue integration)

• To develop specific, efficient and validated analytical methods and protocols to predict and to assess the loading and the (*in vitro* and *in vivo*) release profiles of biomolecules from different formulations

Milestones

• M1.1: Analytical methods and protocols compendia on aerogel-based pharmaceutical products and medical devices for wound healing and bone repair (month 24)

• M1.2: Knowledge on optimization of manufacturing processes for the production of aerogel based pharmaceutical and medical devices with proper physicochemical and biological properties (month 42)

List of major deliverables

• D1: STSM to groups in WG5 and joint publications on chemical, physical and microbiological stability and health risk assessment on aerogel-based materials for biomedical applications (month 30)

• D2: STSM to groups in WG4, joint publications, conference and training school on aerogel processing technologies for pharmaceutical and biomedical applications (month 33)

• D3: STSM to groups in WG3, joint publications and review paper on analytical and biological protocols used to predict and to assess materials performances (physicochemical and biological properties) as well as biomolecules and formulations *in vitro* and *in vivo* activities (month 42)

• D4: Review and workshop on aerogel-based pharmaceutical and biomedical products (month 45)

WG2. Environmental applications of aerogels

Objective – To design and develop new functional aerogel-based products for sound insulation, targeted absorbents and adsorbents, catalysts and sensors, as well as to explore the reuse and valorisation of by-products in aerogels through the biorefinery approach

Tasks

• Screening, selection and testing of aerogel materials properties for targeting sound insulation

- Formulation of aerogels as adsorbents and absorbents for air cleaning, water pollutant treatment and detection of contaminants
- Design of high-performance aerogels as matrices for catalysis and for electrochemical applications
- Development of bio-aerogels via biorefinery approach and from waste bio-products

Activities

- To explore the use of aerogel-based materials for sound insulation as a critical aspect to mitigate acoustic contamination in e.g. construction and transport applications
- To test aerogels "as is" as absorbents/adsorbents of metal ions, or to modify them by post-functionalization for e.g., selective absorption (oil spillage) or adsorption (VOCs, heavy metals)
- To develop alternative materials made with templating methods to synthesize aerogels with tuneable pore size and surface chemistry as matrices for catalysis, analytical and electrochemical applications
- To evaluate the use of bio-aerogels, a third generation of aerogels based on polysaccharides and proteins, for various applications (acoustic and thermal insulation, absorption, adsorption, catalysis, advanced food materials, active packaging). When synthesizing bio-aerogels a special attention will be paid on the biorefinery approach which should involve the use of all components which Nature provides and waste bio-materials

Milestones

- M2.1. Compendia of novel routes for bio-aerogels using biorefinery approaches (month 18)
- M2.2. Compendia of approaches towards aerogel-based acoustic insulating products (month 24)
- M2.3. Compendia of functionalization approaches for adsorption/absorption applications (month 30)
- M2.4. Compendia of materials for catalysis and/or electrochemical applications (month 36)

List of major deliverables

- D5: Review on using the bio-refinery approach for the preparation of bio-aerogels (month 18)
- D6: STSM to groups in WG3 and joint publication on functionalization of aerogels for targeted environmental applications (month 30)
- D7: STSM to groups in WG3&4, joint publications and recommendations on processing pathways for the use of aerogels as absorbents and adsorbents (month 36)
- D8: Review, workshop and training school on aerogels for environmental applications (month 45)

WG3. Materials engineering and characterization

Objective –For the biomedical and environmental applications, fundamental and applied research will be conducted to impart aerogels application-specific properties such as hydrophilicity, lipophilicity, ultra-low density, flame retardation, tailored porosity, nanomorphology or surface chemistry

Tasks

- Fundamental research on biopolymer self-assembling in solution state, coagulation after anti-solvent addition and gel formation. Novel surface modification techniques imparting aerogels specific sorption (oil, heavy metals, organic pollutants) and/or capabilities for catalysis/electrochemical applications
- Development and tailoring of aerogel in the form of particles, beads and scaffolds for biomedical (drug delivery systems, medical devices in wound healing, scaffolds for regenerative medicine) and environmental (acoustic insulation) applications
- Development of analytical and *in situ* tools for modelling the 3D-structure of aerogels and measuring/predicting physicochemical and mechanical properties of the resulting materials

Activities

- To combine aerogel technology with other processing technologies (e.g., emulsion, plasma treatment, supercritical foaming, 3D-printing, jet milling) to get synergies and enhanced properties regarding mechanical, physicochemical, microbiological and biological performances
- To explore materials engineering approaches to get interconnected macropores in aerogels as well as mechanical reinforcement strategies to reach the mechanical demands for scaffolds as bone grafts
- To exploit innovative characterization techniques and modelling tools for the screening of aerogel formulations and for the prediction of the materials performance

Milestones

- M3.1: Compendia of protocols for manufacturing and post-processing of aerogels (month 15)
- M3.2: Compilation of synthesis and post-processing of aerogels with tailored properties (month 27)
- M3.3: Compilation of analytical and modelling tools for characterization of aerogels (month 36)

List of major deliverables

- D9: Workshop and training school on aerogels engineering, characterization and modelling (month 9)

• D10: STSM to groups in WG1&2, joint publications and workshop on approaches for processing and post-processing of aerogels evaluated for biomedical and environment applications (month 27)
• D11: STSM between WG3 members and review on analytical tools and modelling approaches for the characterization of gels, aerogels and their post-processed counterparts (month 36)
• D12: External documents on the impact of aerogel processing conditions and post-processing modification measures on final properties of the products (month 48)

WG4. Process engineering, development and scale-up for industrial applications

Objective – To develop process design guidelines for aerogels manufacturing on an industrial scale

Tasks

• Development of design procedures for unit operations required to manufacture different types of aerogels with various morphologies (monolithic, powder, beads) on an industrial scale, integration of unit operations and process optimization for minimizing costs of production
• Identification of environmental, health and safety issues (handling of aerogels, use of chemicals, operation at high pressures, atmospheric emissions, etc.) and develop guidelines to address them
• Development of guidelines for scaling up from pilot to industrial scale

Activities

• To produce various aerogels (inorganic, organic and hybrid) in various forms (powders, beads, monolithic blocks) in the laboratory and pilot scales
• For production of powders and beads, to develop and validate models for predicting parameters such as gelation time, droplet size, droplet size distribution, stirring power requirements as a function of concentration of reactants, solvents and surfactants. For production of monolithic blocks, to develop models for predicting gelation times as a function of reactant concentrations
• To identify effective unit operations for gel bead separation from gelation baths and develop designs
• To develop models for prediction of solvent exchange times, determination of solvent composition, and determination of processing requirements for supercritical (sc-) drying of aerogels and scale-up

Milestones

• M4.1: Compendia of reagents-solvents-other admixtures combinations suitable for manufacturing of aerogels with various morphologies and guidelines for process integration (month 24)
• M4.2: Compilation of models for gelation, solvent exchange and sc-drying, and scale-up (month 36)
• M4.3: Compendia of effects of process variables on end textural properties of aerogels (month 45)

List of major deliverables

• D13: Industry-academia forum on biomedical and environmental applications of aerogels (month 15)
• D14: STSM in WG3-groups and joint papers on gelation and solvent exchange models (month 33)
• D15: STSM in groups of WG4 and joint publications on models for supercritical drying and scale-up from pilot scale data (month 42)
• D16: Expert opinion and conference on design aspects for an industrial plant for aerogels production for biomedical and environmental applications (month 48)

WG5. Toxicity, health, risk assessment and regulatory aspects

Objective – To create the framework of health risk assessment of aerogel-based materials for its use in specific biomedical and environmental applications

Tasks

• Selection of adequate personal protective equipment and indoor air cleaning devices for use during aerogels production and handling
• Health risk and life cycle assessment of aerogels for biomedical applications
• Health/biota risk and life cycle assessment of aerogels for environmental applications

Activities

• To evaluate the associated health, environmental and exposure risks related to aerogel production
• To perform the specific panel of tests for each biomedical application foreseen for aerogel-based compounds (e.g., bacterial/viral load, allergen potential, exposure assessment)
• To perform the specific panel of tests for aerogels in insulation materials and active surfaces

Milestones

• M5.1. Compendia of health and safety procedures for production, handling and transport of aerogels
• M5.2: Compendia of safety regulatory for environmental application of aerogels-based materials identifying at least one health risk category (month 24)
• M5.3: Compendia of safety regulatory for biomedical applications of aerogels compounds, identifying at least one health risk category (month 36)

List of major deliverables

• D17: Conference and training school regarding advices and regulatory aspects on health risk, life cycle assessment and management on aerogel-based production and application (month 21)
• D18: External documents and conference regarding hazard identification, exposure assessment of aerogel-based used in biomedical and environmental approaches (month 39)
• D19: Recommendations on handling and exposure of aerogels for future market and post-market actions on aerogel-based materials used in biomedical and environmental approaches (month 45)
• D20: Expert opinion as white paper about health risk and management on aerogel-based materials to be forwarded to OECD (month 48)

3.1.2. GANTT DIAGRAM

Month	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
MC meeting																
WG&CG e-meetings																
Conferences																
Training schools																
STSMs																
Web update																
Reporting																
Involved deliverables			D9		D13	D5	D17		D10	D1 D6	D2 D14	D7 D11	D18	D3 D15 D12	D4 D8 D19	D16 D20

The COST Action duration is set to 4 years. Management Committee (MC), Core Group (CG) and Working Group (WG) meetings will be carried out yearly in conjunction with COST-scientific meetings, except for the kick-off meeting. Meetings will be performed in the MC–CG–WG order for optimization of the cascade of information. Training schools will be carried out just after COST-conferences for optimization of resources. STSMs will already start during the first year and throughout the Action lifetime. A website devoted to this Action will be implemented during Q1Y1 and will be operative until two years after the end of the Action for the dissemination of the latest results. Scientific and financial reports for progress and ultimate success of the Action will be delivered during the Q4 of each year.

3.1.3. RISK AND CONTINGENCY PLANS

The initial consortium of the Action is believed to assemble the expertise and facilities needed to undergo the tasks specified in each Working Group to reach the objectives of AERoGELS Action. To ensure these objectives, the Chair and the MC will give a common vision about the project to all members, and promote a good control of quality, costs and deadlines of activities. The contingency plan (below) will be under the responsibility of the MC and the CG-members concerned by the risk.

Risk description	Mitigation measures	Contingency plan
Deviation in the initial chronogram	Cockpit with the current achievements of the SMART Action objectives is monthly updated in the Intranet of the Action to follow up the progress and alignment with the Action timeframe	Systematic examination of the deviation source. Once identified, the contingency measure will range from new members/events to timeline revision and changes in the CG-organigram.
Scientific pitfalls and dead ends threatening a WG	Action progresses are lively monitored and deviations from the initial objectives should be promptly detected	WG-reinforcement by recruiting new participants and search of synergistic interactions by specific STSMs
Scientific misconduct of a WG	Research coordination objectives are evaluated each trimester by the Chair and the associated WG-leader informed	Organization of a specific session on this topic within a COST event during the next Action year
Difficulty to promote the participation of ECIs	39% of the first Action consortium are already ECIs which should ensure a strong commitment of ECI's in all parts and events of the Action	If needed, STSMs/events/training schools will be preferentially assigned to ECIs and/or new young talents will be recruited in the consortium
Difficulty to promote academia-industry interactions	11 industrial partners already part of the Action. Organization of in-house workshops and BtoB meetings to foster interactions	If needed, STSMs/events/training schools will be preferentially assigned to industrial partners

Difficulty to reach a gender balance	53% of partners are already females which should ensure gender balance in all parts and events of the Action	If needed, STSMs/events/training schools/WG-leadership will be preferentially assigned to females
Difficulty to organize training events	All COST-members will join their efforts to find skilled lecturers and to promote high attendance	Implementation of a call to find skilled experts. Search for new forums to announce the events

3.2. MANAGEMENT STRUCTURES AND PROCEDURES

The MC will be appointed to follow-up the progress and to supervise the appropriate allocation of funds to reach the Action objectives. MC will meet yearly in conjunction with a COST-scientific meeting. During these one-day meetings, the MC will decide on the approval or modification of the Work and Budget plans and calendar for the forthcoming scientific and networking events and mobility opportunities in the next time period.
The CG will be formed by 14 members embracing the key leadership positions of the COST Action: Chair, Vice-Chair, 10 WG (co-)leaders, Grant holder and STSM coordinator. These roles and the Grant Holder Institution will be elected by the MC during the first MC-meeting. At least 4 members of the CG will be representatives of COST ITCs. At least 3 ECIs will be present in the CG-organigram.
The roles of the CG-members are supplementary and cover all the expected tasks to reach the defined Action objectives. The Chair will be responsible for the coordination and implementation of the Action-activities: MC-meetings (agenda, minutes…), joint applications, work and budget plans, and progress and final scientific reports. The Chair should supervise the alignment of the activities with the objectives set in the Action MoU and periodic Work plans. The Vice-Chair will assist the Chair in the coordination activities and the wide dissemination of the Action's events and activities. The Vice-Chair will also have a key role in the implementation of scientific events for ECIs. WG-leaders and co-leaders are in charge of the coordination of their WG to reach the deliverables and milestones (Section 3.1.1) on time as well as to fulfil their specific research coordination objectives (Section 1.2.1). The Grant holder will implement all the administrative and financial tasks linked to the Action. The STSM coordinator will promote and lead the organization of mobility opportunities. The STSM coordinator will work in close collaboration with the Vice-Chair in the drafting of the agenda of scientific events for ECIs to encourage interdisciplinary programs and the mentoring of transversal skills.
Each CG-member will be responsible of the organization of a COST Action scientific meeting. The eligible applicants for each scientific event and activity will respect an appropriate gender balance and a number of ECIs of at least one third in the COST-seminars/workshops/conferences and 100% in the training schools. The participation of industrial partners in the events will be considered an asset of the Action and thus promoted, since this may catalyse networking and project initiatives based on innovative ideas which may lead to knowledge transfer opportunities.
Regarding the STSMs, the selection will consider the potential for enhancement of the research interaction between the involved parts, measured by the impact of the exchange expected by the applicants. A tentative goal of 10% of STSMs to the industrial members is set. Standardized forms for the STSM applications and subsequent reporting/surveys will be developed by the STSM Coordinator. This will guarantee a uniform monitoring of the success of individual STSMs, as well as evaluation of the fulfilment of the participants expectations. The STSM Coordinator will proactively inform, through the national representatives of the participating COST countries and in the Action website, about the eligibility rules for the STSM applicants and the financial support rules.
The application of ECIs (PhD students or young postdoctoral scientists) to the Action events will be encouraged by the STSM Coordinator, WG-leaders and Action members, considering their area of research and impact on their learning needs. The objective of gathering applicants contributing to gender balance, participation of non-COST countries and academia/industry interaction will be also emphasized in the exploitation plan. For visibility and a closer involvement of the ECIs in the Action events, a period in each event will be devoted to the dissemination of the ECIs' scientific results (ECIs' Forum) followed by their discussion with senior researchers, stimulating connections that may fruitfully support these ECIs in the future. Open access dissemination of results and IPR topics can also be discussed in these forums, taking advantage of the experiences of the senior researchers. The ECIs who participate in these forums may apply to the best published article of the year, being first author or corresponding author of the article. A prize for the best joint research collaborations within the Action members will award its Open Access publication in a Q1-percentile journal. The MC will select and announce them in the forum and these works will be highlighted in the Action website.

3.3. NETWORK AS A WHOLE

The AERoGELS Action hasa consortium of researchers from internationally renowned groups. Gender balance criterion will be respected in the consortium and the MC during the Action lifetime. ECIs represent a major part of the consortium members and their participation will be boosted by the Action activities (STSM, forums, conferences, trainings). Participation of industry in the Action will be encouraged during the Action lifetime.
The consortium embraces internationally renowned groups in the field regarding expertise and access to cross-cutting processing and analytical techniques, raw materials as well as end applications. All the sectors of the value chain are represented: raw material producers, R&D, technology providers, end product manufacturers and regulatory experts. Nevertheless, a foremost principle of the Action will be to incorporate other groups with complementary or transversal skills during the Action lifetime to broaden the scope and to exceed the expectations of the Action. The initial consortium embraces 3 non-COST Countries.•Costa Rica is a country with remarkable environmental and health indicators, as a biodiversity hotspot and with one of the highest rate of renewal energy production in the world. However, an alarming deforestation rate is a major scientific issue in the country. Costa Rica will contribute to the exchange of scientific knowledge in AERoGELS with the mutual benefit of a sustainable development model. •Russia has wide range of natural resources and is one of the fastest growing worldwide healthcare market. Russia is thus a top-ranked country in scientific-technological developments for environment and biomedical applications. The share of knowledge with Russia in AERoGELS will have a mutual benefit in developing aerogels for these applications. •Jordan is greatly concerned on environmental and health aspects with very limited water and mineral resources and a sudden increase of the population due to refugees. The participation of Jordan in AERoGELS will strengthen WG1&2 with the mutual benefit of new technologies for handling water with limited resources, and for biomedical challenges in these regions

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